

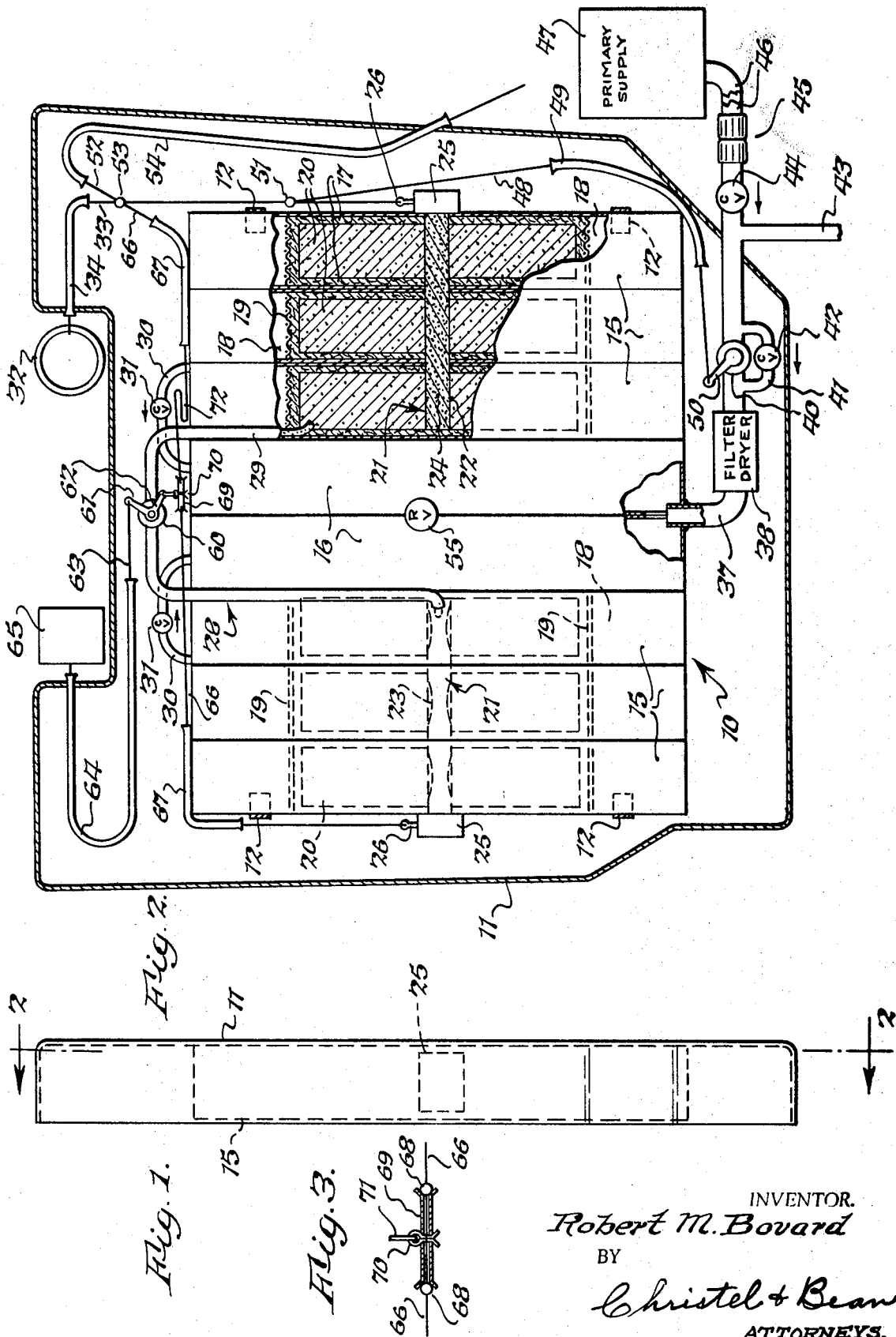
Oct. 27, 1970

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3,536,456

OXYGEN SUPPLY SYSTEM

Filed April 3, 1967



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Filed Apr. 3, 1967, Ser. No. 628,138

Int. Cl. B01j 7/00

U.S. Cl. 23—281

10 Claims

ABSTRACT OF THE DISCLOSURE

Two groups of solid state chemical oxygen generators are fastened within the lid of a survival seat in an aircraft and are sequentially actuated either manually or automatically upon pilot emergency to provide oxygen to a common reservoir communicating with a face mask worn by the pilot. Each group of generators has a common ignition area, the ignition area of the second group being connected by an ignition train to the generators of the first group for ignition of the second group simultaneous with exhaustion of the generators of the first group. A petcock is operable to interrupt the ignition train and thus the firing sequence whereby normally there will be a continuous flow of oxygen from the sequentially actuated groups but flow from only the first group can be provided, the second group having separate actuating means for its ignition area for providing oxygen independently of the first group at a subsequent time.

BACKGROUND OF THE INVENTION

This invention relates to a breathing fluid supply system and particularly to a self-contained breathing fluid supply system including sequentially ignited solid state chemical breathing fluid generators adapted but not limited for use aboard an aircraft with provision for interrupting the ignition sequence between generators for subsequently igniting the breathing fluid generators thus held in reserve.

A self-contained breathing fluid supply for aircraft is desirable for emergency use as a substitute for the primary breathing fluid supply and as a portable supply carried by the pilot. A solid state chemical breathing fluid generator is particularly desirable in this respect as it is inert and can be stored for long periods of time. When actuated, generators of this type usually continuously provide breathing fluid until spent, there being no provision for stopping and re-starting the individual generator. Consequently, should only a single auxiliary generator be provided in an aircraft, the pilot will lose all of his breathing fluid reserve upon actuation thereof and will have no auxiliary breathing fluid available for subsequent emergencies or otherwise.

A plurality of generators can be provided with each generator being actuated by the pilot as needed. However, reliance upon individual actuation of each generator is undesirable since a pilot can be incapacitated or otherwise unable to actuate succeeding generators. Moreover, size and weight limitations in aircraft are critical and the overall capacity of the individually actuated generators typically would be reduced to accommodate the apparatus for such individual actuation. Additionally, the capacity and consequent duration of the individual generators is limited and the pilot's attention, particularly in emergency situations, ought not to be directed to the necessity of continuously actuating the generators. The provision of a reserve chemical solid state breathing fluid supply system in an aircraft which is adapted for use in multiple emergencies poses problems to my knowledge

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heretofore unsolved and to which the present invention is directed.

SUMMARY OF THE INVENTION

It is a primary object of the present invention to provide a breathing fluid supply system having a plurality of normally, sequentially ignited, solid state, chemical breathing fluid generators wherein the ignition sequence can be interrupted and the remaining unspent generators independently actuated as needed. This is accomplished in accordance with my invention by providing an ignition train connecting the ignition area of a second generator with a first generator so that breathing fluid is generator from the second generator only when the first generator is spent, together with an ignition train breaker operable to interrupt the ignition train whereby the second generator may be held in reserve for future use, the second generator having a separate actuator operable independently of the ignition train.

It is another object of the present invention to provide a breathing fluid supply system having the foregoing characteristics wherein the sequential ignition of the generators can be interrupted only by positive action of the user. In accordance with my invention the ignition train breaker is normally in a non-interrupting position and requires positive traction on a pull block associated therewith to interrupt the ignition train.

It is yet another object of the present invention to provide a breathing fluid supply system having the foregoing characteristics wherein the second generator normally is incapable of independent actuation. To this end, I provide a separate actuator for the second generator connecting with the ignition train breaker through a disabling apparatus which normally prevents external actuation of the second generator and which is released only in response to interruption of the ignition train to permit independent operation of the separate actuator.

A further object of the present invention is to provide a breathing fluid supply system having the foregoing characteristics wherein both generators are connected to a common pull-ring, thereby affording independent actuation of the generators in a simple and unconfusing manner. In a presently preferred form, a pair of interconnected cables connect with the actuators, the cable associated with the second generator normally being prevented from actuating the latter by the disabling apparatus and having sufficient slack between the ring and the disabling apparatus to permit actuation of the first generator.

Still another object of the present invention is to provide a breathing fluid supply system having the foregoing characteristics and configured for placement within the lid of a survival seat provided in an aircraft.

In one aspect thereof the present invention is characterized by the provision of a pair of solid state, chemical breathing fluid generating units, fluid conduit means communicating with the generating units and having an outlet adapted for connection to a user, ignition means for each generating unit, means for sequentially actuating the generating units including means for initially igniting only the ignition means associated with one of the generating units, the sequential actuating means being arranged to ignite the ignition means of the other generating unit substantially simultaneously with exhaustion of the breathing fluid generating capacity of the one generating unit to provide a substantially continuous flow of breathing fluid into the conduit means, means for interrupting the sequential actuating means to prevent ignition of the other generating unit, and separate means for igniting the ignition means associated with the other generating unit, whereby the supply of breathing fluid can be interrupted and the other generating unit held in reserve for subsequent actuation.

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The foregoing and other objects, advantages and characterizing features of the breathing fluid supply system of the present invention are pointed out in the following detailed description of a typical embodiment thereof considered in conjunction with the accompanying drawing depicting the same wherein like numerals represent like parts throughout the various views.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

FIG. 1 is a side elevational view of the lid of an aircraft survival seat containing the breathing fluid supply system of the present invention;

FIG. 2 is a somewhat schematic, horizontal cross-sectional view thereof with portions of the breathing fluid supply system broken out for ease of illustration, being taken about along line 2—2 of FIG. 1; and

FIG. 3 is a fragmentary, enlarged cross sectional view of the disabling apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENT

There is shown in the drawing one form of a breathing fluid supply system constructed in accordance with the principles of the present invention and comprising an oxygen generating unit, generally designated 10, suitably secured within the lid 11 of a survival seat as by clips 12. The lower portion of the survival seat is not shown as it forms no part of the present invention. Unit 10 comprises a plurality of elongated cylindrical canisters arranged in side by side relation and having length and diameter dimensions suitable for locating the same within the confines of lid 11, the latter having for example lateral dimensions on the order of fourteen by fifteen inches and a depth of one and three quarter inches. In the illustrated form, eight canisters are provided with a group of three canisters on each side of unit 11 serving as oxygen generators 15 and with the two central canisters 16 serving as a primary reservoir. It will be understood that greater or fewer oxygen generating and reservoir canisters can be provided and that, while the preferred form provides an equal number of like oxygen generating canisters in each group, variations in the number and/or size of the oxygen generating canisters of each group can provide different oxygen generating capacities for each group if desired.

Each oxygen generating canister 15 comprises a metallic or ceramic tube having a suitable shape-sustaining envelope of filter and insulating material 17 lining the interior of tube 15, the ends of material 17 being spaced from the ends of tube 15 to provide a pair of secondary reservoirs 18 at opposite ends thereof. Screen disks 19 about the ends of material 17 further filter the generated oxygen as it passes into reservoirs 18. Canisters 15 contain oxygen generating candles generally designated 20 encased within lining material 17. Oxygen generating composition 20 preferably comprises a cast or compacted body of a composition containing a chlorate or a perchlorate which generates oxygen upon combustion, a metal powder such as iron or carbon for burning and supplying part of the heat needed for combustion, a binder such as inorganic glass fibers for holding the mass together and aiding in the even decomposition of the chlorate or perchlorate, and a peroxide for chemically eliminating traces of chlorine gas released during thermal breakdown of the chlorate or perchlorate. Such oxygen generating compositions are known and per se form no part of the present invention. In the illustrated embodiment each canister 15 contains a single candle 20, completely enclosed by liner 17 except at the central ignition area.

To facilitate description of unit 10, the group of three oxygen generating canisters 15 on the right in FIG. 2 will hereinafter be referred to as the first oxygen generating group and the three canisters 15 located on the left will be referred to as the second or reserve oxygen generating group. Each group has an ignition section 21 comprising a reduced diameter tube 22 which is inserted

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through registering lateral bore holes formed medially through tubes 15 and candles 20. Tubes 22 have a plurality of axially spaced openings 23 along opposite sides thereof which, when tubes 22 are fully inserted, register with the adjacent faces of oxygen generating candles 20. Tubes 22 contain an ignition material 24 comprising the foregoing oxygen generating composition enriched with a metal powder, such as iron, to provide a concentrated area of intense heat to ignite the adjacent faces of composition 20. Tubes 22 are closed at their inner ends adjacent reservoir 16 and are provided with ignitors 25 on their outer ends. Ignitors 25 are preferably of the percussion type operable to ignite ignition section 21 in response to the withdrawal of a pin 26, this being conventional as typified by the bouchon of a hand grenade, the details of which are known, form no part of the present invention per se and accordingly require no further description. Other known ignitors could be utilized such as a phosphorus match disc, an electric squib or the like.

An ignition train 2 connects between an end portion of the oxygen generating candle 20 in the innermost canister 15 of the first oxygen generating group and the ignition section 21 of the second or reserve group. Train 28 extends through the ends of the innermost tubes 15 and crosses therebetween externally of primary reservoir tubes 16. Ignition train 28 comprises a material like that in the ignition sections 21 encased within a suitable insulator casing 29.

A pair of conduits 30 connect between the secondary reservoirs 18 of the innermost oxygen generating canisters 15 and the tubes comprising primary reservoir 16, each conduit 30 having a check valve 31 preventing fluid flow from primary reservoir 16 into secondary reservoirs 18. An actuator ring 32, located externally of lid 11, has a lanyard 33 which passes through a guide 34 fixed within lid 11 and connects with ignition pin 26 of the ignitor 25 associated with the first group of oxygen generating canisters 15. Pulling traction on ring 32 withdraws pin 26 from ignitor 25 to ignite the associated section 21 and thereby ignite the adjacent faces of composition 20 in each of the three first group canisters 15. The burning faces of candles 20 propagate axially at substantially equal rates toward both ends of tubes 15. When the composition 20 in the first group of canisters 15 is substantially fully burned, the burning face of composition 20 in the innermost canister will have propagated to the outer end of the latter canister and ignites ignition train 28. Train 28, in turn, ignites the ignition section 21 associated with the second group of canisters 15 to ignite the oxygen generating composition 20 in the same manner as the first group.

The groups are thus sequentially ignited, the second group being ignited substantially simultaneous with the exhaustion of the oxygen generating capacity of the first group whereby oxygen is continuously supplied to reservoir 16 substantially without interruption. In both groups, the generated oxygen passes laterally outwardly and through filter-insulator material 17 into secondary reservoirs 18 and into ignition sections 21, the latter providing cross-communication between the canisters of each group. Thus the generated oxygen in each group flows inwardly from the two outermost canisters thereof through ignition section 21 and into the innermost canister whereupon it flows outwardly through conduits 30 into the canisters forming primary reservoir 16 and outwardly through a supply conduit 37. Canisters 16 are cross connected adjacent conduit 37.

In the illustrated form, supply conduit 37 has a filter-dryer 38 having a chemical absorbent or reactant for removing small amounts of water vapor and contaminants in the generated oxygen, a normally closed valve 40, and a bypass conduit 41 having a check valve 42 preventing outflow of oxygen from reservoir 16. Supply conduit 37 has a branch conduit 43 adapted for connection with the breathing mask worn by a pilot, not shown. Conduit 37

also has a check valve 44 located beyond conduit 43, and a conventional quick-connect disconnection to a primary supply conduit 46 communicating with a primary oxygen supply 47 which can be the usual ships supply comprising conventional pressurized oxygen bottles, not shown. A cable 48 passes through a guide 49 suitably fixed to lid 11 and connects lever 50 of valve 40 with lanyard 33 at 51. A lanyard 52 is fastened at one end to lanyard 33, as at 53, and passes through a guide 54 outwardly of lid 11 for connection to a fixed part of the aircraft for being pulled automatically upon ejection of lid 11 from the craft.

From the foregoing, it is apparent that the pilot normally is supplied with oxygen from primary supply 47 through conduits 46 and 43 and that reservoir 16 normally is pressurized with oxygen from the primary source via supply conduits 46 and 37, the oxygen flowing through bypass conduit 41 past check valve 42. The oxygen supply system can be manually or automatically actuated to ignite the oxygen generating canisters of the first group and to simultaneously open normally closed valve 50 by pulling ring 32 or by traction on lanyard 52 as upon pilot ejection from the aircraft, respectively. In both cases, oxygen is immediately provided to the pilot from pressurized reservoir 16 through supply conduit 37 and valve 50, the check valves 31 in conduits 30 and the check valve 44 in supply conduit 37 preventing oxygen flow into secondary reservoirs 18 and primary supply 47, respectively. Primary reservoir 16 is thus maintained under pressure from primary supply 47 to provide oxygen to the pilot instantaneously upon actuation of the oxygen generating unit and during the brief interval of time required for the latter to attain a sufficient oxygen generating rate. The second generator group is ignited in train 28 automatically upon exhaustion of the first group. The first and second groups of canisters thus sequentially replenish reservoir 16 to normally provide a substantially continuous flow of oxygen through conduits 37 and 43 to the pilot. Reservoir 16 is provided with a relief valve 55 to vent oxygen generated in excess of demand.

Prior to actuation of the system, the reservoir capacity comprises that of the two central tubes 16. After actuation, the reservoir additionally includes secondary reservoirs 18 whereby a large volume of oxygen can be stored at pressures below the pressure required to open relief valve 55. The reservoirs insure a continuous supply of oxygen to the user should there be only momentary delay in ignition of the second generator group, although no such delay is contemplated and the second group is arranged to be fully ignited and supplying oxygen at a full rate by the time the first group stops burning.

It is a significant feature of this invention that the automatic sequential ignition of the two groups of oxygen generating canisters 15 can be interrupted whereby the second oxygen generator group can be held in reserve for use in subsequent emergency situations or otherwise. To this end, an ignition train breaker 60 is located intermediate the ends of ignition train 28. While various types of breakers can be used, breaker 60 comprises a rotary petcock having a bellcrank operator including levers 61 and 62. Petcock 60 includes a portion of the ignition train therethrough and is rotated in response to rotation of lever 61 to remove that portion from the ignition train and thereby interrupt the latter to prevent ignition of the ignition area 21 associated with the reserve group of canisters. Lever 61 is connected to one end of a lanyard 63 which passes through a suitable guide 64 to terminate in a pull block 65 located outside of lid 11. A cable 66 connects at one end with lanyard 33 as at 53 and passes through suitable guides 67 to connect with the actuator pin 26 of the actuator 25 associated with the reserve group of canisters. As seen in FIG. 3, a ball and keeper arrangement is provided intermediate the ends of cable 66, the latter having a pair of spaced balls 68 fixed thereto on opposite sides of a pair of keeper plates 69 mounted in

lid 11. Keepers 69 have outwardly flared ends and are normally biased to spread apart one from the other. A cotter pin 70 extends through keepers 69 to maintain the same sufficiently close together about cable 66 to prevent movement of balls 8 therebetween whereby displacement of cable 66 between keepers 69 and the second or reserve generator ignition section is prevented. Cotter pin 70 is connected with lever 62 of petcock 60 by a line 71.

In use, a pull on ring 32 or traction on lanyard 52 operates to actuate the first oxygen generating group and to open valve 50 whereby oxygen is provided from reservoir 16 and the first oxygen generating group to the pilot as hereinbefore described. There is sufficient slack in cable 66 on the right side of keepers 69 (as seen in FIG. 2) to accommodate the displacement of lanyard 33 or 52 involved in actuating the first generator group. If the emergency or other need for the oxygen thus provided is of such short duration as to be within the burning time of the first canister group, and oxygen is not then required from the second group, the pilot can pull block 65 causing lanyard 63 to rotate lever 61 counterclockwise as viewed in FIG. 2. This moves petcock 60 to a position interrupting ignition train 28 whereby ignition of the second group of oxygen generating canisters is prevented. Such rotation of the bellcrank also causes lever 62 to withdraw cotter pin 70 from keepers 69, thus enabling balls 68 to pass therebetween upon subsequent displacement of cable 66. The second group of canisters can thus be held in reserve and actuated when needed by pulling ring 32 a second time whereby cable 66 is displaced to withdraw pin 26 from the ignitor 25 associated with the ignition section 21 of the reserve generator group. Independent ignition of the second ignition section 21 causes the reserve group of canisters 15 to generate oxygen which passes through conduit 30, through reservoir 16 and out through conduit 37 as before. However, in the absence of a deliberate interruption of ignition train 28 by pulling on lanyard 63, the second group of generators will be ignited automatically as previously described.

It is thus apparent that the objects of my invention have been fully accomplished in that the foregoing oxygen supply system is normally arranged to sequentially actuate plural groups of oxygen generating canisters to provide continuous supply of oxygen but has means for interrupting such automatic sequential operation whereby oxygen generating canisters can be held in reserve for future use. Moreover, the system is provided in a compact arrangement configured for disposition within the limited confines of the lid of an aircraft survival seat and is operable both manually or automatically upon pilot ejection from the aircraft to initially actuate the first oxygen generating group. The common actuating ring 32 provides for both initial actuation of the system and secondary actuation of the reserve group while the interruption of the sequential operation is effected by a pull on a block 65 separate and distinct from ring 32 whereby the oxygen generating canister groups are either sequentially or independently operated in a simple, easy, and unconfusing manner.

Having thus described and illustrated the preferred form of my invention, it will be understood that such description and illustration is by way of example only and that such modifications and changes as may suggest themselves to those skilled in the art are intended to fall within the scope of the present invention which is limited only by the appended claims.

What I claim as new is:

1. A breathing fluid supply system comprising a pair of solid state chemical breathing fluid generating units, fluid conduit means communicating with said generating units and having an outlet adapted for connection to a user, means for sequentially actuating said generating units including means for initially actuating only one of said generating units, said sequential actuating means including an ignition train interconnecting said units and

being arranged to automatically actuate the other of said generating units substantially simultaneous with the exhaustion of the breathing fluid generating capacity of said one generating unit to provide a substantially continuous flow of breathing fluid into said conduit means, means for interrupting said ignition train to prevent such actuation of said other generating unit, and separate means for actuating said other generating unit whereby said continuous flow can be interrupted and said other generating unit held in reserve for subsequent actuation.

2. A breathing fluid supply system according to claim 1 including means normally disabling said separate actuating means, said disabling means being responsive to the interruption of said ignition train to render said separate actuating means effective to subsequently actuate said other generating unit.

3. A breathing fluid supply system according to claim 1 wherein said generating units contain a composition which reacts upon burning to evolve oxygen, said sequential actuating means including an ignition means for each of said generating units and said ignition train extending from adjacent the terminal burning portion of said one generating unit to the ignition means associated with said other generating unit.

4. A breathing fluid supply system according to claim 1 wherein said interrupting means includes a member disposed in said ignition train and movable to interrupt said ignition train, means normally disabling said separate actuating means, said disabling means being responsive to such movement of said interrupting member to condition said separate actuating means for subsequent actuation of said other generating unit.

5. A breathing fluid supply system according to claim 1 wherein said sequential actuating means includes ignition means for each of said generating units and an ignitor for igniting the ignition means associated with said one generating unit, said separate actuating means including an ignitor for igniting the ignition means associated with said other generating unit, means connecting said ignitors with a common operator for actuation thereof, and means normally disabling said separate ignitor during initial actuation of said common operator in igniting the ignition means associated with said one generating unit.

6. A breathing fluid supply system according to claim 5 including means connecting said interrupting means and said disabling means, said disabling means being responsive to interruption of said ignition train to render said separate ignition responsive to actuation of said common operator to subsequently ignite the ignition means associated with said other generating unit.

7. A breathing fluid supply system according to claim 1 wherein said conduit means includes a reservoir, a primary breathing fluid supply communicating with said reservoir, means arranged to normally continuously supply fluid from said primary reservoir to said reservoir, a conduit control valve normally preventing the passage of fluid from said reservoir to said outlet, and means for opening said valve substantially simultaneous with actuation of said one generating unit to supply fluid from said reservoir and said one generating unit to said outlet, said reservoir initially supplying such fluid during the time required for said generating unit to attain a generating rate adequate for use.

8. A breathing fluid supply system according to claim 1 wherein each of said generating units comprises a plurality of elongated individual generators containing oxygen evolving composition and arranged to lie generally in a common plane, said sequential means including ignition means common to the generators of each unit.

9. A breathing fluid supply system according to claim 8 wherein each of said generating units comprises a plurality of elongated individual canisters containing a composition evolving oxygen upon burning, said reservoir comprising at least one elongated canister, said oxygen canisters and said reservoir canister being arranged to lie generally in a common plane with said oxygen canisters located on opposite sides of said reservoir canister, said sequential actuating means including ignition means common to the oxygen generating canisters of each unit.

10. A breathing fluid supply system according to claim 1 wherein said conduit means includes a primary reservoir common to and communicating with each of said generating units, each of said units including a canister containing a body of material evolving oxygen upon burning, said bodies being enclosed in insulating envelopes of filter material and spaced from the opposite ends of the respective canisters thereby to provide secondary reservoirs therein.

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